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CLAIMS

1. An industrial process for recycling every type of waste, comprising the following steps:
 - a) physical preliminary treatment for waste volumetric reduction and compacting, so as to obtain a homogeneous refined mixture free of ferrous/metal and/or too large residues;
 - b) feeding said mixture deriving from step a) into a first chamber of a multistage reactor, in which the mixture undergoes an oxidative demolition-depolymerization process;
 - c) feeding said oxidized mixture deriving from step b) into a solid-liquid extractor, in which the mixture is separated into its components; or
 - d) feeding said oxidized mixture deriving from step b) into a second chamber of said multistage reactor, in which the mixture is activated to a repolymerization process;
 - e) feeding said activated mixture deriving from step d) into a third chamber of said multistage reactor, in which said repolymerization develops, and then into suitable collection or conveying means, in which said repolymerization reaction is completed, so as to obtain a sterile stable expanded polymer;
- said process being characterized in that:

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- said oxidative demolition-depolymerization reaction as in step b) is carried out by intensively mixing the refined waste mixture with a super-oxidizing mixture, in the presence of catalysts;
 - 5 - said repolymerization reaction as in step d) is carried out by intensively mixing said oxidized mixture with a repolymerizing mixture, in the presence of catalysts.
2. The process according to claim 1, in which the
10 single steps thereof are performed in continuous cycle.
3. The process according to claims 1 and 2, characterized in that said super-oxidizing mixture is prepared by mixing two different oxidizing solutions prepared each in two turbo-electrophotolytic reactors,
15 and comprises an amount of highly reactive oxidizing species, such as hydroxyl radicals $\cdot\text{OH}$, ozone O_3 , sodium hypochlorite NaClO , peroxides.
4. The process according to claim 3, in which the
20 first one of said two oxidizing solutions is prepared by treatment in a turbo-electrophotolytic reactor of an acid mixture A) comprising: peroxides, acetic acid, citric acid, stabilizers.
5. The process according to claim 4, in which said
25 mixture A) has the following composition in percentage

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by weight: peroxides, 50-80%; acetic acid, 7-15%; citric acid, 5-13%; stabilizers, 1%.

6. The process according to claim 3, in which the second one of said two oxidizing mixtures is prepared
5 by treatment in a turbo-electrophotolytic reactor of a mixture B) comprising an aqueous phase added with brine.

7. The process according to claim 6, in which said aqueous phase is recycled through waste oxido-
10 destruction process.

8. The process according to claims 6 and 7, in which brine contains NaCl in an amount of 5-10% by weight and is present in an amount of about 10-20% by weight with respect to the recycled aqueous phase.

15 9. The process according to claims 1 and 2, in which said catalysts comprise a mixture of molecular sieves, kaolin, clay, sodium aluminum silicates.

10. The process according to claim 9, in which said molecular sieves are metered from about 1% to about 4%
20 by weight, with respect to the weight of waste entering the reactor.

11. The process according to claim 9, in which before being added to the mixture of catalysts, kaolin is activated by heating at 1200°C.

25 12. The process according to claim 9, in which said

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mixture of catalysts, when used in addition to the super-oxidizing mixture of the demolition-depolymerization reaction as in stage b), has the following composition in percentage by weight: 75% of molecular sieves, 10% of kaolin, 8% of clay, 7% of sodium aluminum silicate blue powder.

13. The process according to claims 1 and 2, in which said repolymerization mixture comprises:

- a mixture of diphenyl-methane-4,4'-diisocyanate and/or isomers and homologues thereof, containing about 25% to 35% of NCO groups, preferably about 30 to 32%; said mixture being dispersed into an isomeric mixture of xilenes;
- diazabicyclooctane (DABCO);
- additives, such as N,N-dimethyl-acetylamine or N,N-dimethyl-aminoethanol;
- catalysts.

14. The process according to claim 13, in which said catalysts comprise the mixture of catalysts according to claim 9.

15. The process according to claim 14, in which in said mixture of catalysts sodium aluminum silicate in blue powder is added in a concentration of 6.5 to 16.5% by weight.

16. The process according to claims 1 and 2, in which

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said mixture fed into said solid-liquid extractor during said step c) is separated into a sterile organic phase, liquid or fluid-dense, and a solid sterile dry phase.

5 17. A system for carrying out the process according to any of the preceding claims, comprising at least:

- a first section, comprising one or more modules, connected one to the other, in which waste is crushed, compacted, homogenized;
- 10 - a second section, comprising a single stage or multistage reactor, in which said refined waste coming from the first section undergoes an oxidative demolition-depolymerization process followed or not by a subsequent repolymerization
- 15 process.

18. The system according to claim 17, in which said first section comprises means for breaking, eliminating metal residues, crushing, refining and compacting waste.

20 19. The system according to claim 18, in which said means are connected in series one to the other through belt conveyors and/or separators and related loading devices.

20 20. The system according to claim 17, in which said second section comprises a multistage reactor includ-

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ing in its turn:

- a device for loading refined waste;
- a first chamber, in which the oxidative demolition-depolymerization process occurs;
- 5 - a second chamber, in which the repolymerization process is activated;
- a third chamber, in which the repolymerization process develops, during the transfer of the waste mixture towards the reactor discharge.

10 21. The multistage reactor according to claim 20, in which:

- said first chamber has a section shaped like a cylinder and a frustum of cone;
- said second chamber has a section shaped like a
15 cylinder and a frustum of cone;
- said third chamber has a cylindrical section.

22. The multistage reactor according to claims 20 and 21, in which said chambers are connected in series one to the other and are provided with means for mixing
20 and conveying the waste mass to be transformed.

23. The multistage reactor according to any of the claims 20 to 22, in which said mixing and conveying means comprise a shaft-free double blade rotary spiral, having the same profile as the reactor chambers.

25 24. The multistage reactor according to any of the

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claims 20 to 23, in which said chambers also comprise means for metering, restoring, recovering and recycling reagents and catalysts.

25. The multistage reactor according to any of the
s claims 20 to 24, in which the oxido-destruction process is carried out continuously.

26. The system according to claim 17, in which said second section further comprises:

- tanks for storing reagents;
- 10 - two turbo-electrophotolytic reactors for producing on-site the super-oxidizing mixture;
- devices for controlling and managing the system.

27. The system according to any of the claims 17 to 26, in which the waste processing process is carried
15 out continuously.

28. The system according to any of the claims 17 to 27, further comprising means for collecting, isolating and separating the products deriving from oxido-destruction treatment.

20 29. A turbo-electrophotolytic reactor according to claim 26 for producing on-site the super-oxidizing mixture, characterized in that it comprises the combination into one reactor body of:

- an electrolytic cell;
- 25 - a photolytic reactor.

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30. The turbo-electrophotolytic reactor according to claim 29, further characterized in that it comprises a cylindrical body into which the following elements are inserted:

- 5 - on one side the UV lamps, housed in a transparent Teflon cylinder;
- on the other side the electrodes, wound as a spiral around said Teflon cylinder.

31. The turbo-electrophotolytic reactor according to claims 29 and 30, in which the fluid to be subjected to the combined electrochemical-photolytic treatment flows between the negative and positive electrode while it is bombed at the same time by UV rays emitted by the lamps.

15 32. A super-oxidizing mixture for carrying out the demolition-depolymerization reaction according to claim 1, comprising a mixture of two oxidizing solutions, obtained by turbo-electro-photolytic treatment of:

20 A) an acid mixture comprising:

- peroxides (50-80% by weight);
- acetic acid (17-15% by weight);
- citric acid(5-13% by weight);
- stabilizers (1% by weight);

25 B) an aqueous phase added with brine (5-10% by weight

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of NaCl) in an amount of 10-20% by weight with respect to said aqueous phase;

characterized in that it contains an amount of highly reactive oxidizing species, such as hydroxyl radicals
5 ·OH, ozone O₃, oxygen O₂, sodium hypochlorite NaClO, peroxides.

33. A repolymerization mixture for carrying out the repolymerization reaction according to claim 1, comprising:

- 10 - a mixture of diphenyl-methane-4,4'-diisocyanate and/or isomers and homologues thereof, containing about 25% to 35% of NCO groups, preferably about 30 to 32%; said mixture being dispersed into an isomeric mixture of xlenes at a concentration of 50-
15 60% by weight;
- diazabicyclooctane (DABCO) in a percentage of 1% by weight;
- additives, such as N,N-dimethyl-acetylamine or N,N-dimethyl-aminoethanol in a percentage of 1% by
20 weight;
- catalysts, in a percentage of 1% to 6% by weight.

34. Use of the process according to any of the claims 1 to 16 for recycling every type of waste.

35. Use of the system according to any of the claims
25 17 to 28 for recycling every type of waste.

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36. Use according to any of the claims 34 and 35, for producing:

- a perfectly sterile fertilizing compost, having a liquid or fluid-dense consistency;
- s - a biologically stable sterile solid dry biomass; or
- a sterile expanded polymer, with elastic skeleton, heterogeneous flexibility and intercommunicating cells.